

# Senegal - Irrigation and Water Resource Management

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# Overview

## Identification

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**COUNTRY**

Senegal

**EVALUATION TITLE**

Irrigation and Water Resource Management

**TRANSLATED TITLE**

Evaluation du Projet Irrigation et Gestion des Ressources en Eau au Sénégal : Rapport de Conception

**EVALUATION TYPE**

Independent Impact Evaluation

**ID NUMBER**

DDI-MCC-SEN-IWRM-2016-v01

## Version

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**VERSION DESCRIPTION**

Anonymized dataset for public distribution

## Overview

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**ABSTRACT**

IMPAQ:

This evaluation report presents findings from the baseline data collected for the Irrigation and Water Resources Management (IWRM) project, which serves as the primary data source for evaluating the activities of the IWRM project. This report provides an overview of the current irrigation and agricultural situation in the Senegal River Valley. Additionally, the report provides a comparison of treatment and comparison households to check for systematic differences between groups at the time of the baseline survey.

In the IWRM, the selection of areas to receive the project interventions was not random. Rather, it was based on a variety of factors, including political, social and environmental. In the absence of random assignment, we will use a Difference-in-Differences (DID) methodology combined with propensity score matching (DID-PSM) to estimate the impact of the IWRM activities. The baseline data includes community level and household level data. Community level data includes information about regional and socioeconomic characteristics of the village. Household level data sets were collected in 3 waves, one for each agricultural season.

Mathematica:

Our goal is to propose the most rigorous and feasible evaluation design that answers the following research questions of interest to MCC:

**AGRICULTURE PRODUCTION**

Have there been changes in the amount of land used for agricultural production? Is land being used for production in different seasons than before?\*

Has crop production improved? Have production methods, including the choice of inputs, changed? Have there been changes to the types of crops produced?\*

What factors are contributing to or constraining changes in agriculture inputs and production? Why are households changing or not changing agriculture production decisions, and how do those reasons vary depending on crop type, growing season, or income level?\*\*

How have changes differed by gender and among different income levels?\*

## USE AND AVAILABILITY OF WATER

Have there been changes in the sources of water used for agricultural production?\*

How has water availability changed, and have barriers or costs to accessing irrigation been reduced? Has the water supply become more reliable?\*

Has the amount of irrigated land increased?\*

Has the role of WUAs changed and how do they impact the use and availability of water?\*

## INCOME

Have household income levels changed, including changes in components of household income, and has income shifted between agricultural and nonagricultural sources?\*

Do farmers perceive an improvement in their living standards?\*

Have agricultural profits changed?\*

## LAND SECURITY AND CONFLICTS

Have perceptions of land tenure security changed? Is there increased confidence in the land tenure system? If so, why?\*

Has the extent of land formalization changed? Is there greater awareness of the process for formalizing land?\*

Has demand changed for formalized land rights and are the costs of formalizing land rights perceived as reasonable?\*

Has the number or severity of land conflicts reduced? Has the type or nature of land conflicts changed?\*

How has the IWRM Project affected women's access to land and irrigation? How has it affected the landless?\*

How have changes in land security perceptions, formalization, conflict, or conflict management affected investments on land?\*

What have been the constraints or barriers to land access? Do these differ depending on gender, income levels, or age?\*

## LAND ADMINISTRATION AND GOVERNANCE

Have local government agencies become more effective at land management, including land allocation, land formalization, and conflict resolution? Is there greater confidence in the efficacy of these institutions?\*

Do institutions receive adequate support to carry out their functions?\*

## SUSTAINABILITY AND EXTERNAL IMPACTS

What are the prospects for the sustainability of project activities post-Compact?\*

What impacts did the project have outside of project areas?\*

Who benefitted from each IWRM activity? Where and when did each activity occur?\*

\* = Impact analysis using a difference-in-differences methodology

\*\*=Descriptive outcomes and implementation analysis using qualitative and quantitative methods

We will address these research questions by using two key analytical methods, as noted in the research question list above. For some research questions, we will employ an impact analysis that uses a difference-in-differences (DID) approach to estimate the causal effects of some IWRM Project activities. Through this approach, we will compare beneficiaries (the treatment group) to nonbeneficiaries (the comparison group) before and after the intervention, using existing baseline data

and data we plan to collect through two follow-up survey rounds. Due to differences between the two regions and in activities implemented, we will analyze impacts of the project separately for the Delta and Podor intervention areas, using the household as our unit of analysis.

We also will conduct a descriptive outcomes and implementation analysis that uses a combination of qualitative and quantitative methods to address additional questions of interest to complement the impact analysis. These include questions about activities that occurred before the baseline survey and those that occurred at the commune level and may have had commune-wide or institutional effects. We will also use mixed methods to examine the mechanisms that brought about project impacts and to better interpret the estimates produced through the DID analysis. For example, if we find that commune-level activities affected outcomes for both the treatment group and a portion of the comparison group, our DID impact estimates will not be able to capture the effects of these activities; instead, we will examine those commune-level activities and their effects qualitatively. Our mixed-methods analysis will draw on an array of data sources, including the household and community surveys, project documentation, secondary literature, and administrative data provided by MCC and local government agencies. In addition, we will conduct key informant interviews and focus groups with project stakeholders and beneficiary groups.

## EVALUATION METHODOLOGY

Difference-in-Difference Propensity Score Matching

## UNITS OF ANALYSIS

Households

## KIND OF DATA

Sample survey data [ssd]

## TOPICS

Topic	Vocabulary	URI
Agriculture and Irrigation		

## KEYWORDS

Irrigation, Difference in difference, Senegal, Agriculture, Resource Management, Propensity Score Matching, Land tenure security

## Coverage

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### GEOGRAPHIC COVERAGE

The evaluation includes coverage of the Senegal River Delta and the Department of Podor

### UNIVERSE

Adult household members living in the areas of the Senegal River Valley in the areas of Delta and Podor.

## Producers and Sponsors

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### PRIMARY INVESTIGATOR(S)

Name	Affiliation
Mathematica Policy Research	

### FUNDING

Name	Abbreviation	Role
Millennium Challenge Corporation	MCC	

## Metadata Production

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### METADATA PRODUCED BY

Name	Abbreviation	Affiliation	Role
Millennium Challenge Corporation	MCC		Review of Metadata

**DATE OF METADATA PRODUCTION**

2016-12-01

**DDI DOCUMENT ID**

DDI-MCC-SEN-IWRM-2016-v01

## MCC Compact and Program

**COMPACT OR THRESHOLD**

Senegal Compact

**PROGRAM**

NOTE: IMPAQ only collected the baseline data and ultimately did not execute the program detailed below. Their program information, and other information within this metadata, is presented for transparency and understanding of the baseline data, but not the final report, which will be produced by Mathematica. IMPAQ: MCC is investing to help improve agricultural sector productivity in the Senegal River Valley (SRV) in the northern part of Senegal, in particular in the Delta of the Senegal River and in the Podor District. This region has the potential to benefit from intensive irrigation interventions because of: 1) Long experience with irrigation schemes in the Valley; 2) Strong support from the Government and the Société Nationale D'Aménagement et d'Exploitation des Terres du Delta du fleuve Senegal et des Valles du fleuve Senegal et de Falémé (SAED) ; 3) Capability of farmers' association to manage large irrigation schemes. The agricultural potential of the SRV has been constrained by the poor quality and limited capacity of existing irrigation and a lack of appropriate drainage systems which raise soil salinity that in turn contributes to low agricultural yields. To overcome these constraints, the IWRM project is investing to improve the: 1) Quality and capacity of the irrigation system and reduce the risk of abandonment of land; 2) Land tenure regulations to secure the land rights of farmers and mitigate conflicts that might arise from ambiguities about property rights. The IWRM Project will also enhance the capacity of local institutions responsible for allocating and managing land rights. Specifically, the IWRM Project consists of the following activities: 1) Delta Activity 2) Podor Activity 3) Land Tenure Security Activity 4) Social Safeguard Measures Mathematica: On September 16, 2009, MCC signed a \$540 million Compact agreement with the Republic of Senegal. The Compact, which entered into force on September 23, 2010 (meaning the five-year timeline for implementation began and Compact funds were formally obligated), aimed to "enable improved agricultural productivity and expand access to markets and services through critical infrastructure investments in roads and irrigation sectors." The five-year agreement consisted of two projects: (1) the Roads Rehabilitation Project, which aimed at expanding access to markets and services by reducing transportation time and costs through improvements in strategic roads, and (2) the IWRM Project, which aimed to improve the productivity of the country's agricultural sector by improving the quality and reach of irrigation in agriculture-dependent areas in the north. The Compact was completed on September 23, 2015; implementation activities and funding, which totaled \$432 million, ended at that time. This evaluation covers the IWRM Project. In line with Senegal's 1998 Master Plan for poverty reduction and agricultural development in the Senegal River Valley (SRV), the IWRM Project was designed to address the poor quality and lack of existing irrigation and drainage infrastructure, increase the volume of irrigated water in the SRV, develop newly irrigated land, and eliminate the risk of abandonment of existing irrigable land to increase agricultural productivity. The project also aimed to enable a secure land tenure environment for all those living and farming in the region directly affected by the project by supporting the third phase of Senegal's decentralization policy, adopted in 2013, which shifted land governance authority to local governments and aimed to integrate decentralization into local land governance (World Bank 2015). The IWRM consisted of four activities: (1) the Delta Activity, (2) the Podor Activity, (3) the Social Safeguard Activity (which was not implemented), and (4) the LTSA. This evaluation covers the Delta Activity, the Podor Activity, and the LTSA. The problems the project aimed to address were low agricultural yields and abandonment of land due to poor existing irrigation and drainage infrastructure in the Delta region, nonexistent irrigation infrastructure in Ngalenka, and low investment in the areas due to the insecurity of property rights and the high potential for land conflicts. The IWRM Project endeavored to reach 268,000 beneficiaries, increase household income by 35 percent and improve food security 10-20 years after the start of the project.

**MCC SECTOR**

Agriculture and Irrigation (Ag &amp; Irr)

**PROGRAM LOGIC**

IMPAQ: The IWRM project interventions have the potential to unlock agricultural (and non-agricultural) economic capacities and resources, thereby contributing to reducing poverty in Senegal. Land productivity is significantly higher for irrigated land when compared to rain-fed land. Thus, water management and irrigation activity should provide more reliable irrigation sources to farmers and a potential to improve agricultural productivity and agricultural incomes. Under the assumption that farmers are willing and able to pay for rehabilitation of tertiary channels and land in Ngallenka is fully allocated and land rights in delta are formalized, we should observe an expansion in irrigable land and more land area placed under production in the short term. At the same time, we expect the land tenure activity to formalize land tenure rights and improve the

efficiency of local land institutions. Because the lack of formal land tenure rights is a major component of land insecurity, formalizing land tenure rights should increase farmers' feelings of security, which in turn should lead to greater investments in land. Formal land tenure rights, coupled with better and more efficient institutions and land management tools, should help reduce the incidence of land conflicts (medium- and short-term outcomes). The impact evaluation of the interventions will estimate the effectiveness of the interventions in achieving project goals. Mathematica: Irrigation and Water Resource Management Project IWRM Project Logic Assumptions (Delta/Podor) - INPUTS o Budget. Construction works budget is sufficient. - OUTPUTS o Budget. Government of Senegal covers any cost overruns. o Maintenance Action Plan. Irrigation Maintenance Action Plan is approved by GoS and institutional framework activities complete. - IMMEDIATE OUTCOMES o Tertiary Canals. Farmers are willing and able to pay for rehabilitation, expansion and upkeep of tertiary canals and water. In the Delta - collection fee issues have been resolved and system is being managed well (maintenance action plan implemented). In N'gallenka, the government contributes to tertiary canals. o Binding Constraint. Adequate primary Irrigation infrastructure was the biggest constraint. There are no other significant constraints/barriers to increased production (subject of the Ag Sustainability Plan). Particularly, barriers that local rice faces on the domestic market have been addressed, and there is a market for all crops grown. o People know or have access to information on how to use irrigation and grow HVA. o IWRM meets LTSA. Land of N'gallenka perimeter is fully allocated and farmed by trained producer groups holding formal land rights; Delta producers possess formal and up-to-date titling documents; land dispute resolution system is functioning. - INTERMEDIATE OUTCOMES o Sustainability. Farmers continue to pay for water and fees are used for maintenance. o People have access to agricultural inputs. o Post-harvest infrastructure and access to markets are not a constraint - rural road system is adequate to carry inputs and outputs. o Interaction with other Donors. Other programs/donors/ investors are filling gaps in farmer training (what about technical assistance?), credit, etc. o WHAT about an assumption that the rice/tomato/onion meets quality/market standards and that these are in fact being absorbed by market???? - IMPACT o Binding Constraint. Irrigation was the constraint to growth. o Increases in farm income will lead to increases in household income. o Maintenance, land management, allocation and dispute resolution, and fee collection are all continuing to operate. o Baselines/Targets. Pre-compact assumptions about baseline were correct. o There are no other major constraints to ag sector growth (particularly volatility in GoS policy for the agricultural sector, including the interface of imports and domestic production, and ethnic barriers to trust and investment between Dakar and SRB).

#### **PROGRAM PARTICIPANTS**

Beneficiaries are defined as households, owners or shareholders of farming enterprises and households that have individuals employed in the operation of enterprise farms. The IWRM Project was estimated to benefit approximately 22,390 households, or 269,260 individuals, through their work in agriculture. Based on the average farming revenue explained above, and assuming that households would cultivate an average of two hectares of irrigated land, average post-investment revenues were estimated to be US\$4,470 PPP, which is a US\$1 PPP per person per day increase in income. It was estimated that approximately 20 percent of beneficiaries of the IWRM Project were extremely poor, 15 percent were poor, and 42 percent were near poor. MCC also estimated that the project would provide employment for 8,880 households or 104,950 individuals. Assuming an average provision of 335 labor-days per household, these households would, on average, earn around US\$1,740 PPP per year.

# Sampling

## Study Population

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Adult household members living in the areas of the Senegal River Valley in the areas of Delta and Podor.

## Deviations from Sample Design

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### Mathematica:

In the Podor region, IMPAQ was not able to identify its treatment sample since they did not know at the time of baseline data collection which households in the treatment area would be allocated land in the new irrigation perimeter. Consequently, they asked ANSD to survey (1) all 1,617 households enumerated from the census in the treatment area, with the intent that a substantial portion of the surveyed households would eventually be treated, and (2) a random subsample of 585 households in the comparison area to meet sample size requirements from their power calculations.

## Questionnaires

No content available



## Data Collection

### Data Collection Dates

Start	End	Cycle
2011-12-01	2012-03-30	Passage 1
2012-04-01	2012-07-31	Passage 2
2012-08-01	2012-11-30	Passage 3

### Data Collection Notes

Only baseline collected so far.

IMPAQ:

Because most of the key outcome variables relate to agricultural production, they are season-dependent. Senegal has three cropping cycles. To obtain reliable farm production/yields estimates, MCA-S decided to interview producers shortly after each harvest. As a result, three waves of data have been planned for the baseline and follow-up surveys in the Delta and Podor areas to cover the different agricultural seasons. The three seasons are:

- Passage 1 - December 1, 2011 - March 31, 2012 [Contre Saison Froide ]
- Passage 2 - April 1, 2012 - July 31, 2012 [Contre Saison Chaude]
- Passage 3 - August 1, 2012 - November 31, 2012 [Rainy season].

### Data Collectors

Name	Abbreviation	Affiliation
Agence Nationale de la Statistique et de la Démographie	ANSD	

## **Data Processing**

### **Data Editing**

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ANSD was contracted by MCA-Senegal to conduct baseline data collection.

### **Other Processing**

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ANSD was contracted by MCA-Senegal to conduct baseline data collection. This included data entry.

## Data Appraisal

No content available